Midterm Exam 02 (2016 Fall)

PHYS 203B: College Physics

Date: 2015 Oct 13

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 75 minutes.
3. There are 9 questions in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**10 points.**) The average cost of energy delivered to residences by electrical transmission in Illinois is 0.12 USD per kWh. At this price, calculate the cost of leaving a 100.0 W porch light on for two weeks while you are on vacation.

2. (**10 points.**) Two identical capacitors store different amounts of energy: capacitor A stores 8.0×10^{-3} J, and capacitor B stores 2.0×10^{-3} J. The charge stored in capacitor B is $1.0\,\mu$C. Find the charge stored in capacitor A.

3. (**10 points.**) A potential difference $V = 10.0\,\mathrm{V}$ is applied across a capacitor arrangement with two capacitances connected in parallel, $C_1 = 10.0\,\mathrm{nF}$ and $C_2 = 20.0\,\mathrm{nF}$.

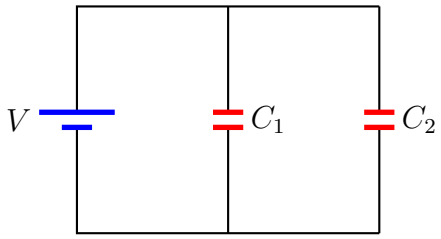

Figure 1: Problem 3

(a) Find the equivalent capacitance.

(b) Find the ratio V_1/V_2 of the voltages across the capacitors.

(c) Find the ratio Q_1/Q_2 of the charges on the capacitors.

(d) Find the ratio U_1/U_2 of the potential energies stored inside the capacitors.

4. (**10 points.**) Figure 2 shows three resistors connected in parallel to a battery. The battery has a voltage of $V = 10.0\,\text{V}$, and the resistors have equal resistances of $R = 300.0\,\Omega$.

   (a) Determine the equivalent resistance across the battery.

   (b) Determine the voltage across each of the resistor.

   (c) Determine the current passing through each resistor.

   (d) Determine the power consumed by each resistor.

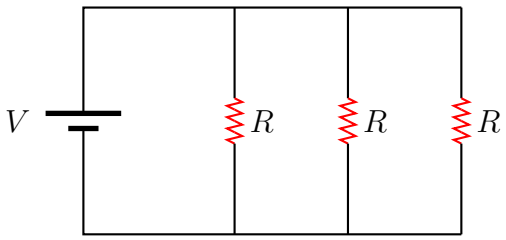

Figure 2: Problem 4

5. (**10 points.**) In Figure 3 determine the equivalent resistance between points a and b. Let $R = 7.00\,\Omega$.

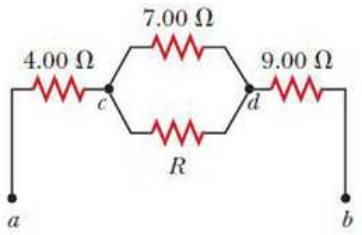

Figure 3: Problem 5.

6. (**10 points.**) In the circuit in Figure 4 determine the charge on capacitor C_1. Let $V = 10.0\,\mathrm{V}$, $C_1 = 10.0\,\mathrm{nF}$, $C_2 = 20.0\,\mathrm{nF}$, and $C_3 = 30.0\,\mathrm{nF}$.

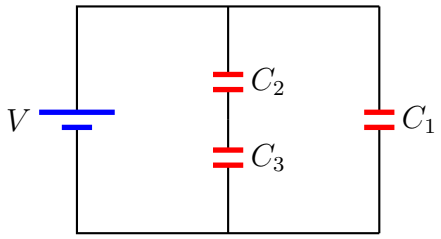

Figure 4: Problem 6.

7. (**10 points.**) A parallel-plate capacitor has an area of $5.10\,\mathrm{cm}^2$, and the plates are separated by 4.4 mm. The capacitor stores a charge of 400.0 pC. What is the potential difference across the plates of the capacitor?

8. (**10 points.**) The resistance R of a wire of length l and uniform area of cross-section A is given by

$$R = \frac{\rho l}{A}, \tag{1}$$

where ρ is the resistivity of the wire. You melt the wire and recast it to have a new length $l' = 10\,l$ (keeping the volume $V = Al$ of the wire constant). What is the new resistance of the wire, if the original resistance of the wire was $100.0\,\Omega$.